rain. If this is the case, our problem is to induce this fungus to thrive during dry weather or find some parasite that will hold the mealybug in check until the rainy season begins.

IT PAYS TO CONTROL RUST MITE

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Strange to say, the rust mite is not an insect but is more closely related to spiders. It is a near kin of the itch mite, "red bugs," red spiders, and cattle ticks. It feeds on all new green growth of trees: leaves, fruit and twigs. It seems to live on juices taken from trees, particularly the oil. However, if these mites consumed all the oil from the glands they open we would have no real rusty fruit. In fact, the rusty appearance of fruit, leaves and twigs is due to the oil oozing from glands that had been tapped by the mites. The oil flowing from the punctured glands spreads out more or less over the rind of the fruit and during nights of heavy dew or light showers may run down the sides of the fruit in narrow bands; the exposure of these thin layers of oil to the air causes the oil to break down or oxidize and change to a dark color, thus resulting in rust and where it had run down the fruit in streaks to "tearstaining."

There is another effect that the exuding oil has on young fruit and other newly developed parts of trees that should be mentioned in this connection. In 1914 and 1915, I punctured a large number of oil glands on newly hardened young twigs and half-grown oranges with a very fine pointed needle under a lens. The punctured areas were marked and kept under observation during some weeks. Small amounts of oil escaped from each pricked oil sack and spread over tiny spots and areas, the shape of which depended upon the action of gravity on the escaping oil. After a few days the distribution of the oil was definitely and clearly shown by brown spots of the exact size and shape of the oil-covered area. In order to make a further test of the effects of orange oil on the epidermal tissues of fruit, leaves and twigs of orange and grapefruit, a small quantity of this oil was obtained and applied with an atomizer so as to cover the surface with tiny spots of oil; in other cases the application was continued until the oil spots became so numerous and close together that they eventually touched and thus covered considerable areas completely with a continuous film of orange oil. The result was interesting in that in case of the light applications every point, formerly occupied by oil-dust particles delivered by

the atomizer, was shown by a tiny brown spot. Where the applications had been so heavy that considerable areas were covered with a continuous film, these areas showed up of the same size and shape as brown blotches. On closer examination the outer skin of these oil covered spots was found to have been killed, leaving a rough outer surface consisting of broken, dead skin tissue adhering to an imperfect substitution skin underneath. In a few cases of extra heavy application of orange oil the entire bark was killed to the wood on twigs as large as a lead pencil, thus resulting in the death of the twigs.

In making these tests with needle pricks and atomizer, I was trying out a suspicion that melanose and ammoniation spots may be due to the bursting of oil glands and the consequent exudation of their contents to the outer surface where the effect of the oil would damage the epidermal layer or outer skin of newly grown leaves, fruit, and twigs. It is evident that the oil is a factor in the development of melanose and ammoniation or dieback spots but the reasons for the escape of the oil from the sacks to the outside must be found before a full explanation can be given. In case of the disease known as melanose it appears that probably abortive infections from spores of the stem-end-rot fungus permit the leakage of the oil and thus result in melanose spots.

Coming back now to the appearance we call rust, one need only examine a very rusty orange that had an early infection, with a hand lens, to see that the outer skin has been killed and that its broken fragments are adhering to an imperfect inner one. This is true only of russeting that is due to an early attack of rust mites on fruit. In case rust mite does not become very numerous until after the fruit has attained considerable size, however, the oil injury following is not so serious and usually gives rise to smooth russets. The rough russets due to the early attacks of rust mites are commonly called buck-skin or shark-skin fruits.

The effects, then, of rust mite on fruit are considerable and various, depending upon the relative earliness and intensity of the infestation and on the weather conditions prevailing during the period of greatest activity. For example, tear-staining can probably result only during periods of comparatively dry weather so that the exuded oil accumulating in spots of intense mite activity may be carried down the sides of fruit in streaks by dew deposits thus allowing concentrated action of the oil, while

rains probably dilute the oil to such a degree and wash it off so quickly that no discoloration can result in streaks. Again, a comparatively late attack of the mite will result only in smooth russets and practically no buck-skin effects. In any case, however, it is evident to everyone who observes the presence and activities of the enormous numbers of mites on heavily infested trees that the devitalizing effects of this pest on trees must be more in proportion to their numbers than to their size.

The immediate and most striking loss to growers due to the unhindered development of rust mites in bearing groves is of two kinds: the discoloration of the rind of fruit, and stunting effect on the fruit growth occasioned by the injuries on the rind. The devitalizing effects on trees necessarily also affects fruit size but probably tells heavier on the performance of trees the following season.

(Excerpt from Citrus Leaf No. 7, published May 1, 1921, by the Florida Insecticide Company, Apopka, Florida.)

The negro caretaker of the Reid Bryan nursery reports that he has sprayed every month with "miserable oil." Some of it is, we'll say!
